 GLAST LAT SPECIFICATION	Document # LAT-PS-00795-02	Date Effective 14 Nov 2002
	Prepared by(s) Mai-Anh Byron	Supersedes None
	Subsystem/Office Calorimeter Subsystem	
Document Title Calorimeter CDE Wrapping Procedure		

Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

Calorimeter CsI Crystal Detector Element (CDE)

Optical Wrapping Procedure

DOCUMENT APPROVAL

Prepared by:

Mai-Anh Byron
Swales

Date

Approved by:

Bob Kraeuter
CAL Project Manager

Date

W Neil Johnson
CAL Subsystem Manager

Date

Nick Virmani
CAL R&QA

Date

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	18 June 2002	Initial Release
02	14 Nov 2002	Modified wrap length and wrapping process

Table of Contents

1	Introduction/Objective	5
2	Special Instructions.....	5
2.1	Quality Assurance.....	5
2.2	Safety	5
3	Applicable Documents and Drawings	6
3.1	GLA ST Documents.....	6
3.2	SAI Documents.....	6
4	Procedure	6
4.1	Manufacturer's (3M) Cautions.....	6
4.2	Wrapping Process; Molding VM2000 Film.....	7
4.3	Wrapping of CsI Crystal (CDE)	9

1 Introduction/Objective

The Calorimeter CsI Crystal Detector Element (CDE) units are composed of a CsI crystal log and two photodiodes with their corresponding flex-cables (PDA) bonded to each end of the crystal. To ensure that the highest percentage of the light passing through the CsI crystal is transmitted to the photodiodes at each end, the CDE shall be wrap with 3M's Radiant Mirror Film known as VM2000. The goal of this process is to create a tight wrap around all surfaces of the crystal. The wrap shall contain no wrinkles, crinkles or voids along the entire length of the CsI crystal and in addition to these requirements, no adhesives of any kind shall touch the crystal's surfaces.

VM2000 is a thin, flexible, non-metallic, polymeric mirror that specularly reflects more than 98% of visible light. The VM2000 that will be used in this procedure's application is 63.5 microns thick and does not contain any adhesive backing. Because of the thickness and physical properties of the material, it is very difficult to fold, wrap or create any kind of a crease in VM2000. Hence, to facilitate in creating a tight wrap around the crystal, the VM2000 in this process shall be preformed in a mold at 120°C +/-5°C for 2 hours.

This procedure documents the molding and wrapping steps to be followed for all bonded CsI crystals for the GLAST Calorimeter Engineering Unit. All uses of the bonded crystals shall be considered as ESD sensitive and shall be governed by the NASA-STD-8739.7.

2 Special Instructions

2.1 Quality Assurance

The performance of this plan will be under the cognizance of Quality Assurance (QA) and Engineering Personnel. The QA shall:

- Verify all material certifications.
- Visually inspect items to be assembled and assembly setup for handling and safety constraints.
- Verify that the static grounds are continuous.
- Verify that all working areas' room temperature, relative humidity (RH) and dew point are within the CsI (TI) crystal specifications.

During the CDE wrapping process, the Responsible Engineer (RE) shall maintain a chronological history log of all the various integration processes and the dates on which they were performed. In addition to this, the log should also contain any pertinent events such as assembly/integration problems, movement or transportation dates and locations, and any inadvertent mechanical or electrical damage.

2.2 Safety

All required personnel shall become familiar with this procedure and its precautions prior to use. All safety and handling requirements in the "Calorimeter Crystal Handling Procedure" (LAT-SS-00607-01) and "CDE Contamination Control Plan" (LAT-MD-00228) shall be followed. Since the CDE wrapping process shall include either cured or partially cured silicone based products, a controlled area shall be cordoned off and kept free of any hardware, tools, and gowning attire that do not pertain to the CDE project. Any items that are placed in this silicone work area may be at risk of contamination.

In this procedure, "CAUTION" precedes operating procedures and practices that may result in damage to equipment if not followed correctly. "WARNING" precedes operating procedures and practices that may result in personnel injury or damage to hardware if not followed correctly.

3 Applicable Documents and Drawings

3.1 GLAST Documents

LAT-DS-00095	“Calorimeter CsI Detector Element Spec.”
LAT-MD-00228	“GLAST LAT Contamination Control Plan”
LAT-SS-00607-01	“GLAST LAT Calorimeter Crystal and CDE Handling Procedure”

3.2 SAI Documents

B7357	“Bar, Crystal, Wrap Mold Fixture, CDE, GLAST”
B7358	“Top, Fixture, Wrap Mold Fixture, CDE GLAST”
B7359	“Bottom, Fixture, Wrap Mold Fixture, CDE, GLAST”
B7456	“Assembly, Crystal Wrap Mold Fixture, CDE, GLAST”
B7689	“Assembly, Crystal Wrap Fixture”
B7690	“Base, Crystal Wrap Fixture”
B7691	“Clamp, Crystal Wrap Fixture”
B7692	“Hold Down, Crystal Wrap Fixture”
B7693	“Base Foot, Crystal Wrap Fixture”
B7694	“Clamp Stop, Crystal Wrap Fixture”

4 Procedure

4.1 Manufacturer’s (3M) Cautions

- VM2000 is composed of several different polymeric materials that may swell if certain types of cleaning solvent are allowed to penetrate into a particular polymeric layer (particularly along the cut edges). Expansion in the material will change the thickness of the material and therefore may compromise the optical and/or physical properties of the VM2000. Therefore, do not use any cleaning solvent to clean the VM2000. Use dry nitrogen and/or clean-room wipes only to clean the surfaces the VM2000. Handle the material with powder-free nitril gloves at all times. Any VM2000 that is not being used at current time should always remain in protective bags or enclosures to protect it from foreign debris and scratches.
- VM2000 contains a protective polyethylene layer on the external layers of the film. The reflective layers of interest are embedded in the internal layers of the film. Minor scratches on the outside surfaces will not affect the reflective properties of the material. If any significant scratches are evident on the sheet of VM2000 that is to be used for this procedure, verify that the material is still acceptable optically before continuing to use the film (a reflection of red light will indicate that the reflective layers have been scratched.)

- VM2000 does not have a preferred grain that delivers better reflective properties. The film has the same optical properties when used in any direction. VM2000 does, however, contain one surface that is more reflective than the other. The more reflective side will have a blue hue when the film is curled into a funnel shape and a light source is shining down its length. The less reflective side will have a yellow hue when the film is curled into the same funnel shape and a light source shining down its length.

4.2 Wrapping Process; Molding VM2000 Film

- 1) Clean all working areas free of debris and dust particles before beginning any work so that the hardware and reflective material is not contaminated.
- 2) Cut a strip of VM2000 that is 100 ± 1 mm wide \times 324 ± 0.5 mm long.
- 3) Clean the cut strip of VM2000 using a high-grade clean-room wipe and/or dry nitrogen only.

CAUTION: Do not use any solvents to clean the reflective film else wrap's optical properties may be compromised.

- 4) Clean the wrapping mold top and bottom (PN: B7358 & B7359 respectively), and the dummy aluminum crystal bar (PN: B7357) using clean-room wipe and 100% ethyl alcohol. Allow parts to air dry before continuing process. Dry nitrogen may be used to decrease drying period. Wrapping mold tooling is shown in Figures 1a & 1b.

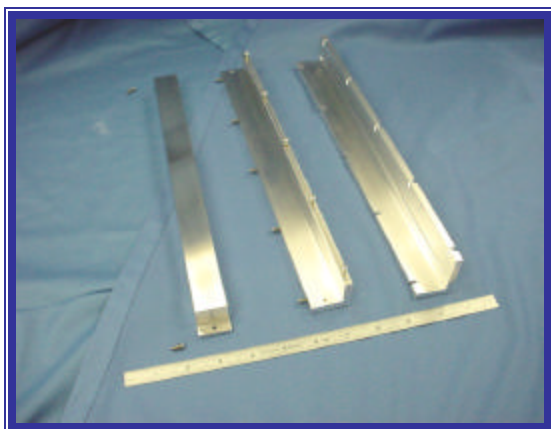


Figure 1a: Wrapping Mold Fixture: Top, Bottom, Al "Crystal"

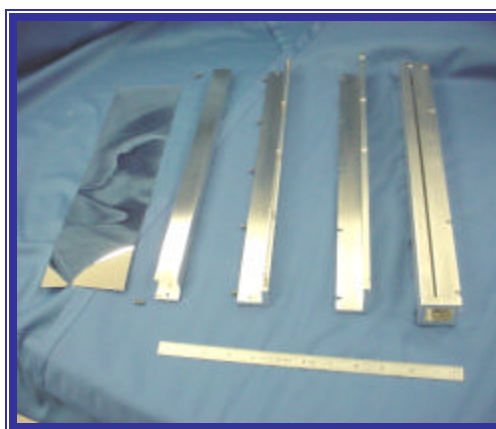


Figure 1b: Cut Reflective Film & Wrapping Mold Fixture Shown Assembled & Unassembled

CAUTION: It is possible to put VM2000 in tension or compression thus possibly expanding or shrinking the film from its original dimensions. Any changes made to the thickness of the material will compromise the optical properties of the film. Care should be taken at all times to not stretch, stress or shrink the reflective film (especially when it is in a hot stage).

- 5) Lay the cut strip of VM2000 between the mold bottom (PN: B7359) and the aluminum crystal bar (PN: B7357) as shown in Figure 2. Be sure that the VM2000 surface which mates with the aluminum crystal bar is the more reflective side (i.e. the blue side). Adjust the reflective wrap as necessary so that the overlapped edge is centered along the length of the aluminum bar and the ends are flushed with the surfaces that simulate the ends of the true crystal. (See drawing B7456 for further details. Figures 2-4 depict the VM2000 forming process.)

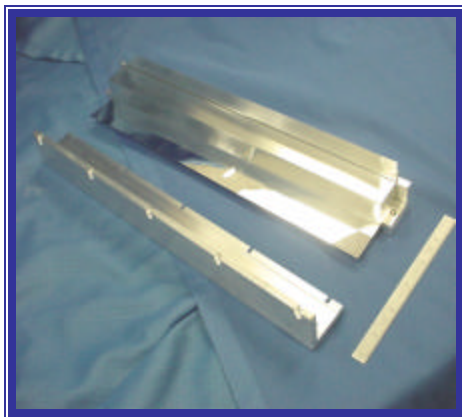


Figure 2: Wrapping Mold Fixture with Al “Crystal” & Reflective Film in Place

- 6) Once the VM2000 is aligned properly, tighten the two #4-40 mounting screws to secure the reflective film and aluminum bar in place.
- 7) While gently guiding the VM2000, close out the mold with its top (PN: B7358) so that the film folds neatly over the aluminum bar. Tighten all hardware, 10 places, to clamp the film in place. (See Figure 3a & 3b.) (Additional c-clamps may be used to increase the clamping force of the mold if necessary.)

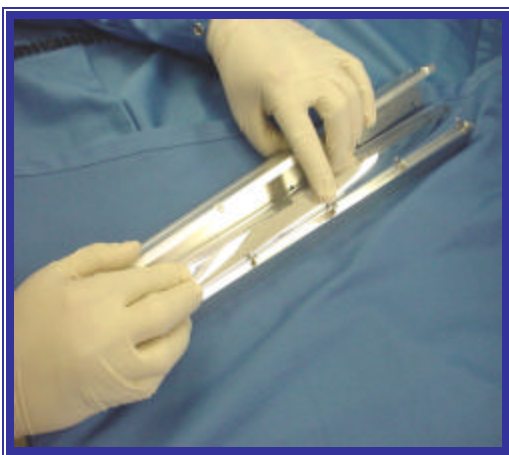


Figure 3a: Closing Out Wrapping Mold Fixture

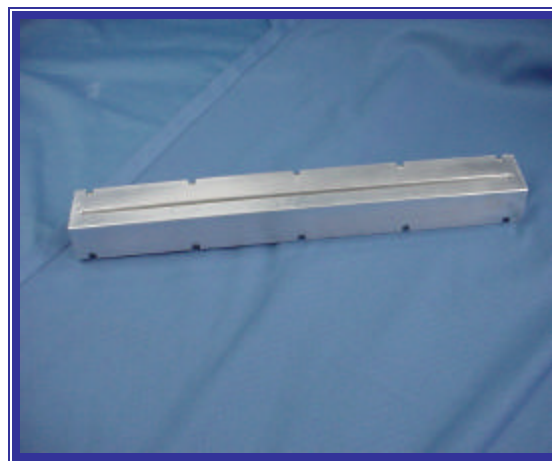
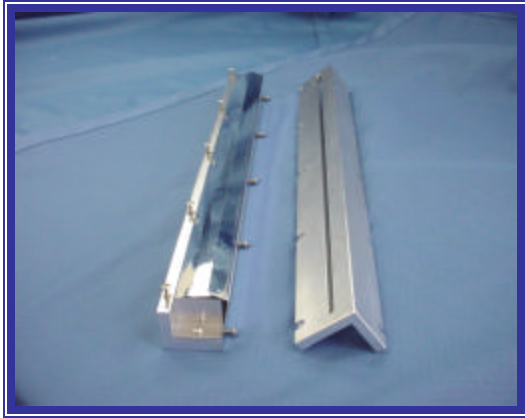


Figure 3b: Assembled Wrapping Mold Fixture with Reflective Film & Dummy Al “Crystal” Secured in Place

- 8) Visually inspect the assembly at both ends of the mold to ensure that the film is not laying improperly in the mold.
- 9) Bake the completed assembly in an oven at 120°C for 2 hours.
- 10) Remove the mold assembly from the oven and allow the mold to cool for 25-30 minutes before opening the mold.
- 11) Loosen the close out hardware, 10 places, and remove the mold lid.
- 12) Loosen the two mounting screws at each end of the dummy crystal and remove the dummy crystal from the mold.

CAUTION: Do not use a sharp object of any kind to remove the molded VM2000 wrap from the aluminum crystal. Do not remove the film by sliding the material down the length of the dummy crystal else the wrap's surface may be scratched and damaged.

- 13) Carefully open the preformed VM2000 film and remove it from the aluminum crystal. The reflective film should now be formed to the nominal dimensions of the CsI crystal and all its geometric tolerances. (See Figures 4a & 4b)



Figures 4a: Molded Reflective Film in Mold Fixture

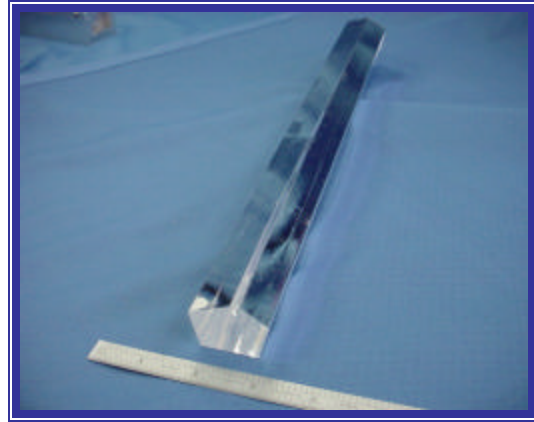


Figure 4b: Formed Reflective Film

- 14) Store the molded wraps in a dust free area until the bonded CDE is ready to be wrapped. Molded wraps formed at 120°C for 2 hours may be stored for several weeks before any true wrapping has to be performed. The longer the molded wrap is left open to room temperature, the more the material will relax hence increasing the difficulty in creating a tight, wrinkle and crinkle free wrap around the CsI crystal. (One week is an ideal maximum waiting period for the molded VM2000 film.)

4.3 Wrapping of CsI Crystal (CDE)

CAUTION: The CsI crystal is very brittle, ductile and can be easily stressed. Cradle and support the crystal along its entire length during all handling operations. Handle it apart from its supporting channel as little as possible. Handle the crystal only with powder-free nitrile gloves.

CAUTION: CDE contains ESD sensitive components. All personnel handling the assembly should wear wrist straps and be grounded at all times. NASA-STD-8739.7 shall be followed during all handling and transportation of CDEs.

CAUTION: Photodiode contains an unsupported soldered wire bundle. Care should be taken during all handling procedures to avoid pulling, bending, or twisting of the wire bundle in any manner.

- 1) Retrieve a bonded CDE for the wrapping process. Transport the CDE from one workstation to the next by using approved ESD sensitive carrying containers that cradle the crystal along its entire length. Be sure that the CDE is constrained properly and is not allowed to slip, slide or bang against other surfaces within the container. Figure 5 shows the items that will be necessary for this section of the procedure.
- 2) Turn the knob located on the front side (PN: B7691) of the wrapping fixture (PN: B7689) until the adjustable plate is retracted to its opened position. (Do not remove the adjustable plate from wrapping fixture.) Figures 5-8 depict the CDE wrapping process. See Figure 6 and drawing B7689 for details.

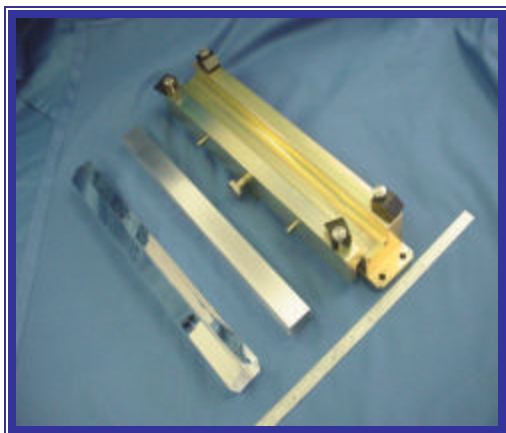


Figure 5: CDE Wrapping Fixture, Formed Film & Sample CDE Log

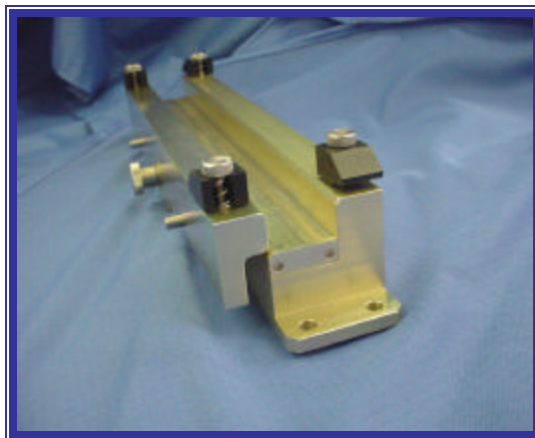


Figure 6: Wrapping Fixture Shown with Clamp Reflective In Fully Open Position

- 3) Place a molded VM2000 film and a bonded CDE into the crystal wrapping fixture. Insert the bonded CDE into the fixture with the inscribed fiducial "V" on the top surface. In this orientation, the wire bundle will leave each PDA in the upward direction, away from the base of the wrapping fixture, and the VM2000 seam to be taped in Step 8) will be on the V face of the crystal. Square the CDE and its wrap against the vertical standoff as shown in Figure 7a & 7b. Adjust the wrap as necessary until all the CDE surfaces (including the four chamfers) are aligned correctly with the same respective surfaces on the molded film.
- 4) Turn the knob clockwise until the adjustable front plate rests against the soft bumper and its inside surface gently cradles the CDE front surface. Guide the formed VM2000 as necessary so that reflective film is clamped correctly against the crystal's parallel surface (See Figure 7a). Be sure no wrinkles, crinkles or folds made in the film's surface.
- 5) Turn the four thumbscrews located on the top surface of the wrapping fixture to their open positions. Slide the four clamping fingers onto each thumbscrew with their tapered ends pointing away from the fixture. See drawing B7689 for details.

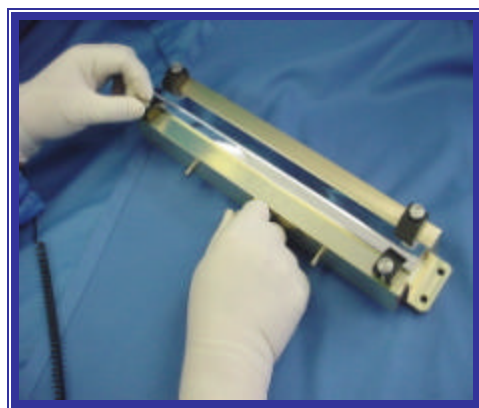


Figure 7a & 7b: Reflective Film & CDE (AI CDE shown) Clamped, Aligned & Square with Wrapping Fixture

- 6) Once the four fingers are aligned in place, spin the fingers 180° so that their tapered ends are now pointing inward hovering above the crystal's top surface.

- 7) Tighten the thumbscrews until the fingers lightly clamps down on the crystal and its VM2000 wrap. Verify that the wrap's surfaces do not contain any wrinkles or crinkles. The reflective film should now be clamped tightly around all the surfaces of the crystal (as shown in Figure 7b) and is ready to be taped in place.
- 8) Secure the reflective film in place along nearly the entire length of the crystal with a strip of acrylic - adhesive Kapton tape, approximately $\frac{1}{2}$ " wide by 0.002" thick. Ensure that the Kapton tape terminates 3 – 5 mm before each end of the VM2000 film. See Figures 8a & 8b.
- 9) Release the wrapped CDE from the wrapping fixture.
- 10) Prepare a label for the CDE on a strip of Kapton tape $\frac{1}{4}$ " wide and 2" long. Write the crystal serial number and an orientation mark on the label. The orientation mark shall be "(+)", to indicate the "Plus" face of the completed CDE. Use a cleanroom-approved permanent marker. A sample label is shown in Figure 9. The label shall be located so that the serial number reads from left to right, with the right edge of the label within 1" of the fiducial "V" on the crystal. The label shall be placed on the "top" surface of the wrapped CDE, near the "plus" end, between the chamfer and the Kapton tape seal. The label must not overlap the chamfer in any way, but it can overlap the tape seal if necessary. The total permissible build-up of material is one layer of VM2000, one layer of Kapton tape seal, and one layer of Kapton label. (The maximum build-up on other areas of the top surface is two layers of VM2000 and one layer of Kapton label.) The assembly of the CDE is now complete.



Figure 9: Sample CDE Identification Label

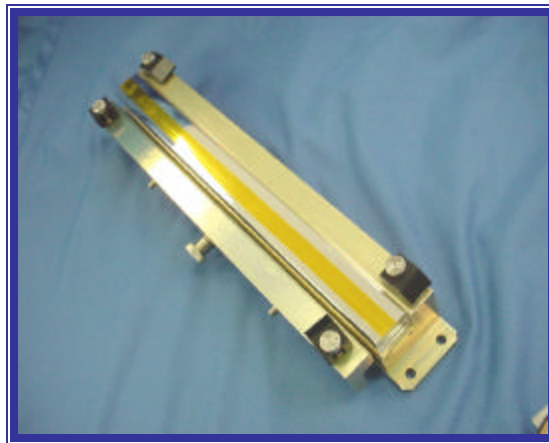
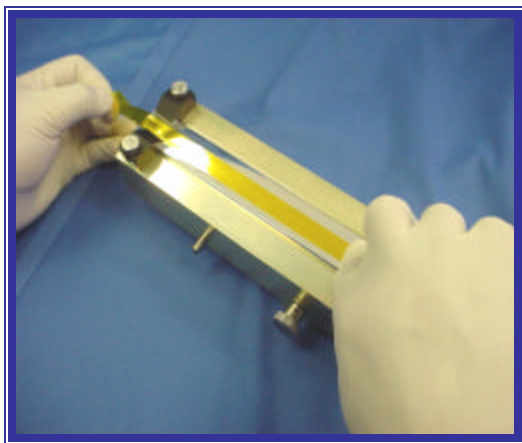


Figure 8a & 8b: Reflective Film Secured in Place with Kapton Tape

CAUTION: The Thallium doped Cesium Iodide, CsI (Tl), crystals are sensitive to relative humidity; hence it is necessary to prevent condensation from forming on the crystals and to prevent damp materials from contacting the crystals. The following are required conditions for the storage and handling of the crystals. (See GLAST LAT Contamination Control Plan (LAT-MD-00228-D2) for details.)

- The environment should maintain a temperature range of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$
- RH should be maintained in the range $40\% \pm 5\%$
- The temperature of the crystals shall never be significantly lower than the room air temperature
- The crystal temperature must never be below the dew point in the room.

If the humidity of the environment is beyond 45% for more than 2 hours, adjustments must be made to correct the environmental conditions.

Store the completed CDE on an ESD-safe flat surface or in an approved ESD-safe CDE storage container.